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## ARTHUR'S UREDINALES OF THE NORTH AMERICAN FLORA.

W. A. KELLERMAN.

This exhaustive monograph constitutes Part 2 of Volume 7 of an important publication which is being issued by the New York Botanical Garden, as rapidly as the Orders are worked up by specialists. This paper is the fourth Part appearing to date.

The Order Uredinales, by Joseph Charles Arthur, as here treated, consists of the three families *Coleosporiaceae*, *Uredinaceae*, and *Aecidiaceae*. The first family occupies pages 85-96, and the second, pages 97-128 of this Part of the Flora; fourteen (of the thirty-seven) genera of the family Aecidiaceae are included in the remaining pages (129-160) of Part 2. Only a few botanists, if indeed any outside the devotees of Uredinology, will not be surprised at the radical treatment of this group — the innovations proposed.

It is the purpose of this review to point out what Dr. Arthur has done rather than to pronounce judgment on any part of his work. For years he has devoted his energies to the study of Rusts. His culture-work, study of life cycles, genetic relationships, and morphology, have prepared the way for, and culminated in this splendid monograph, which we will now proceed to analyze.

The usual anatomical characterization is given of the Order which need not be recounted; but the series of spores can not be

understood unless given in his own words, which are as follows: Spores of five morphological sorts, not all present in every genus;

1. Basidiospores; minute, thin-walled, without surface sculpturing.
2. Pycniospores; small, smooth, of unknown function.
3. Aeciospores; verrucosely sculptured, borne in chains.
4. Urediniospores; echinately or verrucosely sculptured, singly, or sometimes in chains (*Coleosporium*, *Melampsoropsis*.)
5. Teliospores; smooth or variously sculptured but not echinulate, borne singly or in chains.

The last four named may be present but any one or all but the teliospores may be wanting in certain genera. In many genera an alternation of phases is conspicuously shown, says the author, the pycnia (rarely absent) with one other spore-structure comprising the gametophytic phases, and the telia usually with one other spore-structure, the sporophytic phase. In every species the mycelium eventually gives rise to teliospores, which produce in germination four bodies, either remaining within the spore-cell (*Coleosporium*), or borne in the air on a short mycelium, each basidium supporting a single, stalked or sessile basidiospore.

Whether the basidia are internal or external is the fundamental character determining the families; if internal, the family *Coleosporiaceae*; if external, the families *Uredinaceae* and *Aecidiaceae*. The two latter families are readily separated according to the character of the teliospores — they are compacted laterally into a crust or column (rarely solitary within the tissues) in the *Uredinaceae*, and free or fascicled in the *Aecidiaceae*.

Dr. Arthur recognizes for the first family two North American genera — *Coleosporium*, the life-cycle with all spore forms; and *Gallowaya*, with only telia. The latter genus was proposed by the author of the monograph under consideration, last year, before the Botanical Congress at Vienna, to include the single species *G. pini* (*Coleosporium pini* Gall.)

The genus *Coleosporium* is concisely but fully described. Attention is here called to one of the statements, as follows: "Teliospores sessile (by successive formation and by displacement due to lateral pressure often appearing catenulate and pedicellate), one-celled (by early division of the contents appearing four-celled)." Dietel's *Stichopsora* is not recognized as a valid genus, but placed as a synonym under *Coleosporium*.

The synopsis or key to the species (twenty-four in number) of *Coleosporium* is similar in structure to all the species-keys that follow and can be explained in a few words. The main divisions are based on the groups of the hosts. Thus, "Telia and uredinia inhabiting monocotyledonous hosts (*Orchidaceae*)" leads to *C. bletiae*; "Telia and uredinia inhabiting dicotyledonous

hosts" leads to "Hosts belonging to Grossulariaceae" (*C. ribicola*), to "Host belonging to family Loasaceae" (*C. mentzeliae*), etc. In case of some groups (say *Carduaceae*) the tribes are recognized (as *Vernonieae*, *Eupatorieae*, *Astereae*, etc.) in separating the species. Then below this, when there are two or more species, morphological characters are called into requisition. Synonymy and exact citations both for the genus and species are given. The convenient paragraphing of the full though concise descriptions is to be highly commended. Under each species the hosts are enumerated—the family in each case first given; then follow the type locality, the distribution, illustrations when any, and finally the exsiccata are cited.

Four new species of *Coleosporium* are here described, namely, *C. begoniae* from Mexico, *C. lacinariae* from Florida and Alabama, *C. arnicale* from Washington, and *C. occidentale* also from the State last named. Some new combinations are made; thus Dietel and Holway's *Stichopsora mentzeliae* and Schweinitz's *Caeoma* (*Uredo*) *helianthi* are made *Coleosporium*s; and of the latter are listed, as synonyms, Dietel and Holway's *C. viguierae* and *C. verbesinae*. *Uredo terebinthinaceae* and *Caeoma* (*Uredo*) *terebinthinaceae* of Schweinitz are included in *Coleosporium terebinthinaceae* (Schw.) Arthur.

When we turn to the family *Uredinaceae* we realize more fully the radical and progressive mode of treatment. The diagnosis of the family, which has the basidia external, is otherwise sufficiently concise and definite, the main points expressed as follows: *Telia* forming a more or less definite crust or column; teliospores compacted into layers, or rarely solitary within the tissues (*Uredinopsis*), sessile. And this family includes these eighteen genera: *Uredo*, *Physopella*, *Bubakia*, *Pucciniastrum*, *Melampsoridium*, *Melampsorella*, *Hyalopsora*, *Calypsotheca*, *Necium*, *Uredinopsis*, *Melampsoropsis*, *Cronartium*, *Cerotelium*, *Cionothrix*, *Alveolaria*, *Baeodromus*, *Endophyllum*, and *Puccinosira*. Even one claiming to be a uredinologist could scarcely say this list with his eyes shut—in fact he might stumble if his eyes were open!

The genus *Uredo*, *Arthuri* sensu, includes the plants mostly going under the names of *Melampsora* Cast., *Physonema* Lév., *Podosporium* Lév., *Podocystis* Fries, and *Caeoma* Tul. It is evident that this is not the form genus *Uredo* so familiar to all, in service so long, and perhaps destined to further use in the same sense. In fact Dr. Arthur has elsewhere said that he proposes "in his own work to retain such names as *Peridermium*, *Caeoma*, *Roestelia*, *Uromyces*, and *Puccinia* as form genera for imperfectly understood species, and even *Uredo* and *Aecidium* in their customary acceptance as form genera, if a better course does not become evident. These will constitute an *Anhang* for recording undistributed and imperfectly known forms." It is

understood of course that the application of the rule of priority has brought the real generic name *Uredo* uppermost. Our species then are as newly denominated: *Uredo medusae* (Thuem.) Arthur; *Uredo confluens* (Juel) Arthur; *Uredo rostrupiana* Arthur; *Uredo bigelowii* (Thuem.) Arth.; *Uredo albertensis* Arthur; and *Uredo lini* Schum.

The second genus of this family, *Physopella*, includes the *Uredo vitis* Thuem., *Uredo ficina* Juel, *Uredo fici* Cast., *Uredo artocarpi* B. & C., and *Uredo aeschynomenis* Arth. The third genus, *Bubakia*, was based on *Thichobasis crotonis* Cooke; and one more species of our flora is added, namely, *Bubakia mexicana* Arthur n. sp.

The three genera just enumerated constitute the subfamily *Uredinatae* — having their pycnia and other sori subcuticular or originating between the epidermis and mesophyll; the teliospores compacted into dense layers forming a crust; aecia when present with periderm. The next seven genera (Nos. 4-10 of this family) form the subfamily *Pucciniastratae* — having subcuticular pycnia but the other sori originating between the epidermis and mesophyll; teliospores divided by vertical partitions or one-celled, forming imperfect layers, or solitary; aecia when present with cylindrical periderm, rupturing irregularly above. The members of this subfamily are enumerated in the next paragraph.

The genus *Pucciniastrum* Otth, established in 1861, is retained, the genera proposed by Mganus in 1875, *Phragmopsora* and *Thekopsora*, being listed as synonyms. Under this we find the forms well known in literature as *Uredo goodyerae* Tranz., *Uredo hydrangeae* B. & C., *Uredo agrimoniae* Schw., *Uredo arcticus* Lagerh., *Uredo pustulata* Pers. (and *Melampsora epilobii* Fckl.); *Aecidium pyrolae* Pers. (*Melampsora pirolae* Schroet. and *Uredo chimaphilae* Peck), *Melampsora sparsa* Wint. (*Pucciniastrum arbuti* D. & H. and *Uredo copelandi* Syd.), *Uredo minima* Schw. and *Caeoma azaleae* Schw., and *Aecidium* (?) *myrtilli* Schum. (*Melampsora vaccinii* Wint.). The last named species may be taken as a fair case to display the usual synonymy that thorough study develops. The name is used in the monograph is *Pucciniastrum myrtilli* (Schum.) Arth. 1906; the synonyms being:

*Aecidium* (?) *myrtilli* Schum., 1803.

*Uredo pustulata vaccinii* Alb. & Schw., 1805.

*Uredo vacciniorum* DC., 1815.

*Caeoma vacciniorum* Link, 1825.

*Thekopsora* (?) *vacciniorum* Karst., 1879.

*Melampsora vaccinii* Wint., 1881.

*Melampsora vacciniorum* Schroet., 1887.

*Pucciniastrum vacciniorum* Dietel, 1897.

The fifth genus, *Melampsoridium*, established by Klebahn, 1899, includes one species, *M. betulae* (Schum.) Arthur — the aecia on *Larix* not yet found in America, the uredinia and telia on *Betula*, widely distributed. The sixth genus also includes but one species — *Melampsorella elatina* (Alb. & Schw.) Arthur, the aecia on *Abies* and the I and II forms on *Alsine* and *Cerastium*. The seventh genus has this representation: *Hyalopsora aspidotus* (Peck) Magn., *Hyalopsora polypodii* (DC.) Magn., *Hyalopsora laeviuscula* (Diet. & Holw.) Arthur, and *Hyalopsora cheilanthis* (Peck) Arthur; the hosts for these all being plantae polypodiaceae. The next occurs on *Vaccinium* (the aecia on *Abies* not recorded for America), namely *Calypsozona columnaris* (Alb. & Schw.) Kuehn. Then we have a new genus, *Necium*, with the single species, *N. farlowii* Arthur n. sp. on *Tsuga canadensis* (L.) Carr. The tenth genus is exclusively filicicolous, *Uredinopsis*, founded by Magnus in 1893. The American species are *U. osmunda* Magn., *U. mirabilis* (Peck) Magn., *U. pteridis* Diet. & Holw., *U. copelandi* Syd., *U. struthiopteridis* Stroemer, and *U. phegopteridis* Arthur n. sp.

The last two subfamilies of the Order Uredinaceae are *Chrysomyxatae*, with the single genus *Melampsoropsis*; and *Cronartiatae*, with the genera *Cronartium*, *Cerotelium*, *Cionothrix*, *Alveolaria*, *Baeodromus*, *Endophyllum*, and *Pucciniosira*. In both these subfamilies the pycnia and other sori originate beneath the epidermis, and the teliospores are catenulate. In *Chrysomyxatae* the aecia (if present) rupture their periderm apically; in *Cronartiatae*, when present their inflated periderm has circumscissile dehiscence. The urediniospores in the first are catenulate; in the second they are borne singly on pedicles.

We content ourselves with a mere enumeration of the species of the two subfamilies just outlined, most of which will be at once recognized by mycologists: *Melampsoropsis empetri* (Pers.) Arth.; *M. pyrolae* (DC.) Arth.; *M. ledicola* (Peck) Arth.; *M. cassandrae* (Peck & Clinton) Arth.; *M. abietina* (Alb. & Schw.) Arthur; *M. arctostaphyli* (Dietel) Arth.; *M. piperiana* Arthur n. sp.; *M. chiogenis* (Dietel) Arth.; *Cronartium comptoniae* Arth.; *Cr. comandrae* Peck.; *Cr. quercus* (Brondeau) Schroet.; *Cr. ribicola* Fisch. de Waldh.; *Cr. coleosporides* (Diet. & Holw.) Arthur; *Cerotelia canavaliae* Arth.; *Cionothrix* Arthur n. gen. and *C. praelonga* (Wint.) Arthur; *Alveolaria cordiae* Lagerh.; *Baeodromus eupatorii* Arthur; *B. holwayi* Arth.; *B. californicus* Arth.; *Endophyllum rivinae* (B. & C.) Arthur; *End. vernoniae* Arthur; *Pucciniosira pallida* (Speg.) Lagerh.; and *P. brickelliae* Diet. and Holw.

An analysis of the Aecidiaceae will be reserved until the next part of the North American Flora appears with the conclusion of that family.

Here it may be remarked that the large page, clear type,

careful citation, admirable descriptions, host lists, etc., as well as the synoptic keys to the families, the genera, and the species, are all to be most highly commended.

This publication deals with minute plants and as has been well said they must be studied with a corresponding minutia. We may regret it but it was inevitable—the simplicity of the old order of things has disappeared. To know the Rusts is to know their life histories, their spore forms, the structure of the sorus, and the various morphological characters—all of which, together with apparent phylogenetic relationships, have been employed by the author in constructing this exhaustive monograph, epoch making and destined to become classic.

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## AN APPLE ROT DUE TO VOLUTELLA.

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A black rot of apples closely imitating in appearance that caused by *Sphaeropsis*, but differing from the *sphaeropsis* rot in several details, has been observed frequently in various sections of this State, on native apples and on apples shipped into the State from a distance.

In general appearance the disease consists of a rotten black spot upon the fruit. The central and older portions of the decayed region are of an intense coal black color. The younger region of the spot, its outer border, a zone about 14 mm. in width, is brownish.

Close inspection reveals the presence of slightly elevated pimple-like places in the cuticle. These are found to within 3 or 4 mm. of the edge of the spot, and become larger and more pronounced as the center of the spot is approached. Indeed the black color of the spot is due to the thick setting of these black pimples all over its surface. In many instances unless the spot be very old no other development is seen, and the disease might readily be considered to be the ordinary black rot caused by *Sphaeropsis*, and doubtless often passes for it. In older spots however, the pimples are seen to have broken through the cuticle of the apple, and each pimple appears as a small wart-like excrescence, and a good lens shows that it is thickly beset with stiff black hairs. These hairs constitute the distinctive character of this disease, and serve to separate it with ease and certainty from the *Sphaeropsis* rot, provided the rot has developed far enough to exhibit this character.

On slicing the apple open it is seen that the zone most recently invaded is brownish, while all the older portion is black.